

Water Vapor and Zenith Path Delay Time Series Obtained With the Global GPS Network

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The Global Positioning System (GPS) is sensitive to radio signal path delays induced by the atmosphere. That part of the delay due to atmospheric water vapor (about 10% of the total) can be separated from the total delay if atmospheric surface pressure measurements are available. This wet tropospheric path delay, estimated in the vertical or zenith direction, can range from near zero in extremely dry conditions up to about 50 cm in the most humid regions, with a variability up to a few centimeters per hour. One centimeter of precipitable water yields between 6 and 7 cm of zenith path delay, depending on atmospheric temperature. If this temperature is known, precipitable water estimates accurate to 1 to 2 mm can be obtained, with hourly or better time resolution.

Operational processing of data from a global network of GPS stations has been ongoing at the Jet Propulsion Laboratory (JPL) since the summer of 1992. As a byproduct of the standard processing procedure, optimized to yield precise GPS satellite orbits and station locations, estimates of the zenith path delay at each GPS site have been generated and archived. These path delay data provide a potential source of nearly continuous estimates of precipitable water in the atmosphere at over 30 GPS sites around the globe. Thus, these data could enable studies of diurnal through seasonal variability in water vapor as a function of geography and regional climate, and over time would aid in the study of climate change.

We have assembled two-to-three year time series of path delay for a number of these global sites. We intercompare the GPS estimates with those from other, independent techniques, where and when available. We discuss the use of surface meteorological and other related data sets in the recovery of the precipitable water from the path delay estimates. We examine the power spectra of several of these time series to illustrate the frequency behavior of water vapor in different climatic regimes. We discuss possible uses of these data in water vapor modelling studies.

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